

REMARKS

Applicant has discovered a novel nonaqueous electrolyte secondary battery that has, *inter alia*, a negative electrode formed of a particulate negative electrode active material containing carbon fibers and carbon flakes disposed in the interstices between the particulate negative electrode active material. Additionally, the ratio by weight of the carbon fibers to the carbon flakes in the negative electrode is in a range of 0.2 to 100. Claims 10 and 25 additionally recite that the nonaqueous electrolyte solution comprises a mixture of ethylene carbonate and dimethyl carbonate, while claims 22 and 23 additionally recite that the positive electrode and the negative electrode further comprise a binder, including a polyvinylidene fluoride binder.

The carbon fibers improve retention of the nonaqueous electrolyte solution and the carbon flakes disposed between the active material particles improve conductivity (reduce internal resistance). These synergistic effects improve the capacity characteristics of the nonaqueous electrolyte secondary battery. (Page 3, lines 18-29.)

The examiner has required a new title. As can be seen by the above amendments, the title has been amended, so that it is clearly indicative of the invention to which the claims are directed.

The examiner objected to claim 16 on the ground that the limitation of claim 16 is already present in claim 14. As can be seen from the above amendments, claim 16 has been cancelled, so that this ground for objection has been overcome.

The examiner objected to claim 22 on the ground that improper Markush language was employed. As can be seen by the above amendments, the Markush language has been amended, so that this ground for objection has been overcome.

The examiner has rejected claims 1-3 and 5-27 under 35 U.S.C. § 112, first paragraph. In response to the previous office action, applicant proposed amending the claims to recite "carbon fibers and carbon flakes disposed in the particulate negative electrode active material." The examiner suggests that applicant more properly should recite, "carbon fibers and carbon flakes disposed *in the interstices between* the negative electrode active material particles." As can be

seen by the above amendment, the examiner's suggestion has been adopted and the proposed language incorporated into claims 1 and 13, both of the independent claims.

The examiner rejected claims 1, 2, 5-9, 11-14, 17, 19-21, 24, 26, and 27 under 35 U.S.C. 102(b) as anticipated by JP 08-287952A. Applicant respectfully disagrees. JP 08-287952A discloses a nonaqueous electrolyte secondary battery having a negative electrode formed with two distinct layers of carbon material. A layer of spherical graphite, which is identified as "a negative electrode active material layer," is formed so that it contacts the collector. A second layer of scale-shaped graphite, which is termed "an active material layer," is then formed on the surface of the electrode. Fibered graphite can be added to either or both of the two layers.

The examiner argues:

"The layer of spherical graphite contacting the collector can be interpreted as the particulate negative electrode active material. If the scale-shaped graphite (carbon flakes) is formed on the surface of the spherical graphite layer, the scaled-shaped graphite would also be disposed *on* the particulate negative electrode active material." (Emphasis added.)

Applicant respectfully submits that it is improper to equate forming a layer of carbon flakes *on* the surface of a negative electrode with disposing carbon flakes, with disposing carbon flakes *in the interstices between* the negative electrode active material particles. Therefore, JP 08-287952A does not disclose all of the elements of the claimed invention, so that the rejection of claims 1, 2, 5-9, 11-14, 17, 19-21, 24, 26, and 27 under 35 U.S.C. 102(b) as anticipated by JP 08-287952A should be withdrawn.

The examiner also rejected claims 1-3, 5-15, and 17-27 under 35 U.S.C. § 103(a) as obvious in light of a combination of EP 0871 233 and JP 09-027344 A. Again, applicant respectfully disagrees. EP 0 871 233 discloses a nonaqueous electrolyte secondary cell in which flaky graphite is added to the granulated carbon conductive agent used to form the negative electrode. As recognized by the examiner, EP 0 871 233 does not disclose nor would it have suggested additionally including carbon fibers in the conductive material.

JP 09-027344 discloses a nonaqueous electrolyte secondary cell in which a mixture of flaky graphite and fibrous carbon are added to the LiMO₂ conductive agent used to form the positive electrode. The examiner maintains that, "It would have been obvious to one of ordinary skill in the art at the time the invention was made to substitute the carbon granules in EP 0 871 233 A1 with the carbon fibers of JP 09-027344 because they both serve the same purpose of maintaining the structural integrity of the electrode . . ."

However, the conductive materials used to form a positive electrode and a negative electrode are very different materials, LiMO₂ versus particulate carbon. Consequently, it would not have been obvious that a combination of materials that are useful in maintaining the structural integrity of LiMO₂ would also be useful in maintaining the structural integrity of particulate carbon. In fact, JP 09-027344 would actually appear to teach away from the examiner's position. JP 09-027344 discloses a nonaqueous electrolyte secondary cell having a negative electrode. If it would have been obvious to include a mixture of flaky graphite and fibrous carbon to enhance the structural integrity of the electrode, why was it not suggested in JP 09-027344?

Furthermore, nothing in EP 0871 233 and JP 09-027344 A whether consider alone or taken together would have suggested that the addition of carbon fiber improves retention of the nonaqueous electrolyte solution. This unexpected result is significant because if the retention of the nonaqueous electrolyte solution is bad, the ion conductivity will also become bad and the large-current load characteristic will get worse. Therefore, claims 1-27 would not have been obvious in light of a combination of EP 0871233 and JP 09-027344 A and the rejection of these claims under 35 U.S.C. § 103(a) should be withdrawn.

The examiner also rejected claims 10, 22, 23, and 25, the claims additionally reciting that the nonaqueous electrolyte solution comprises a mixture of ethylene carbonate and dimethyl carbonate (claims 10 and 25) or that the positive electrode and the negative electrode further comprise a binder, including a polyvinylidene fluoride binder (claims 22 and 23), under 35 U.S.C. § 103(a) as obvious in light of a combination of JP 08-287952 and EP 0871233. Reconsideration is respectfully requested. The proposed combination would not have suggested a negative electrode material made of carbon fibers and carbon flakes disposed in the interstices between a particulate carbon negative electrode active material.

As discussed above, JP 08-287952 discloses a nonaqueous electrolyte secondary battery having a negative electrode formed with two distinct layers of carbon material. A layer of spherical graphite is formed so that it contacts the collector. A second layer of scale-shaped graphite is then formed on the surface of the electrode. Fibered graphite can be added to either or both of the two layers. This reference does not disclose a negative electrode formed with both carbon fibers and carbon flakes disposed in the interstices between the particulate negative electrode active material.

EP 0871233 is cited merely because it discloses an electrolyte solution comprising a mixture of ethylene carbonate and dimethyl carbonate and a polyvinylidene fluoride binder. Consequently, nothing in a combination of JP 08-287952 and EP 0871233 would have suggested a negative electrode formed with both carbon fibers and carbon flakes disposed in the interstices between the particulate negative electrode active material. Therefore, the rejection of claims 10, 22, 23, and 25 under 35 U.S.C. § 103(a) as obvious in light of this combination of references should be withdrawn.

CONCLUSION

In light of the foregoing amendment and remarks, it is believed that the application is in condition for allowance, so that a prompt and favorable action is respectfully solicited.

Respectfully submitted,

SONNENSCHEIN NATH & ROSENTHAL

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By: _____

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I hereby certify that this document and any being referred to as attached or enclosed is being deposited with the United States Postal Service as first class mail in an envelope addressed to Assistant Commissioner for Patents, Washington, D.C. 20231, on

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Date

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Version with Marking to Show Changes Made

In the Specification:

Please amend the Title as follows:

Nonaqueous Secondary Battery Having a Negative Electrode Containing Carbon Fibers and Carbon Flakes

In the claims:

Claims 1, 13 and 22 have been amended as follows:

1. (twice amended) A nonaqueous electrolyte secondary battery comprising:
a positive electrode comprising a positive-electrode active material;
a negative electrode comprising a particulate negative-electrode active material, the positive-electrode active material and the negative-electrode active material capable of intercalating/deintercalating lithium; and
a nonaqueous electrolyte solution;
wherein the negative electrode further comprises carbon fibers and carbon flakes disposed in *the interstices between* the particulate negative electrode active material, wherein the ratio by weight of the carbon fibers to the carbon flakes in the negative electrode is in a range of 0.2 to 100.

13. (twice amended) A nonaqueous electrolyte secondary battery comprising an electrode composite and a nonaqueous electrolyte solution, the electrode composite comprising a positive electrode comprising a positive-electrode active material and a negative electrode comprising a particulate negative-electrode active material, the positive electrode and the negative electrode being wound by several turns together with a separator disposed therebetween,

wherein the negative electrode further comprises carbon fibers and carbon flakes disposed in *the interstices between* the particulate negative electrode active material, wherein the ratio by weight of the carbon fibers to the carbon flakes in the negative electrode is in a range of 0.2 to 100.

22. (twice amended) A nonaqueous electrolyte secondary battery according to claim 19, wherein the positive electrode and the negative electrode further comprises a binder selected from the group consisting [essentially] of a polyvinylidene fluoride, a polytetrafluoroethylene, an ethylene-propylene-diene copolymer, and a styrene-butadiene rubber.